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Unmanned Aerial Systems for Early Detection of Downy Mildew in Tobacco Fields: Enhancing Financial Outcomes through Precision Monitoring

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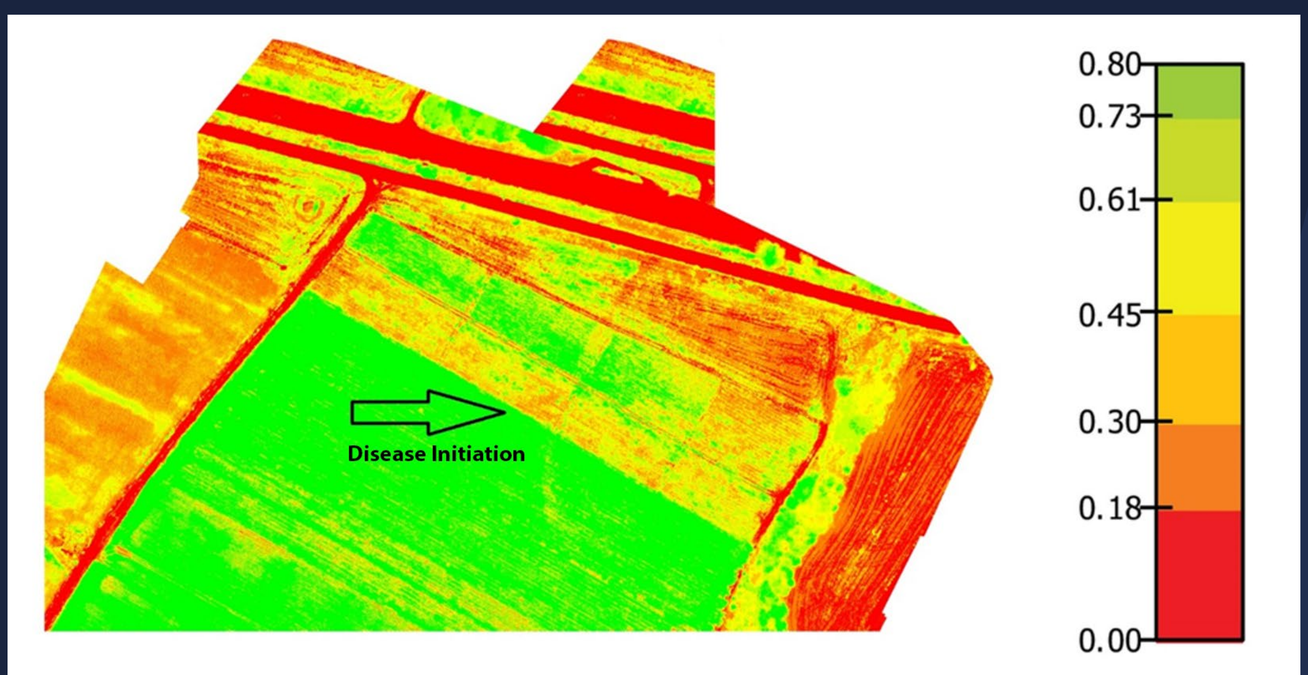
Early signs of blue mould detection in a tobacco field using the NDVI index in a UAV image capture.



1. Introduction

Blue mould (*Peronospora hyoscyami* f. sp. *tabacina*) is one of the most important foliar diseases of tobacco that causes significant losses in the Americas, south-eastern Europe and the Middle East. It was first reported in tobacco-growing areas of Australia during the 1800s. Blue mould epidemics have resulted in annual losses exceeding $200 million in North America (Borras-Hidalgo et al., 2010). The pathogen is capable of infecting tobacco plants in growing regions worldwide throughout the growing season (including transplant production) and can spread rapidly under favourable weather conditions. If the weather is cloudy and cool, the disease can result in complete crop destruction. Early detection and timely management are crucial for successful disease control. In recent years, the integration of unmanned aerial vehicles (UAVs) into agriculture has shown promising results in crop monitoring and disease detection.

2. Methods

- The flight campaign was conducted by Surveying and Geoinformatics company, Exorixi SA, on June 15, 2023, on a vineyard located at Serres, Greece
- UAV multispectral images were acquired with a DT-5Bands imaging instrument, based on the industry-leading MicaSense RedEdgeTM sensor.
- Pix4D software (https://pix4d.com/) was used to manage and process the UAV images.

3. Results

- A set of vegetation indices (VI) were calculated from the five spectral bands (SB) of the UAV images.
- VIs NDRE, OSAVI and NDVI were selected because of their potential relevance to discriminate vegetation's vigor and health.
- The association of this change in plant health with the disease initiation (early symptoms) was done macroscopically

Figure 1. *Peronospora hyoscyami* f.sp. *tabacina* infecting tobacco crops

4. Discussion

Given the high level of training and expertise required, there is a clear need to develop simplified and more automated analysis methodologies for greater dissemination in real operational fields. Di Gennaro et al., (2016) showed high correlation between NDVI index and symptoms from grapevine leaf stripe disease (GLSD). The acquired data assisted the farmer to perform a targeted fungicide application, thus containing the spreading of the disease among the field. By facilitating timely decision-making, farmers can implement appropriate disease management practices to reduce yield losses and minimize environmental impacts associated with excessive pesticide use. Additionally, these technologies strive to ensure traceability and environmental sustainability by minimizing the use of chemical inputs (Sassu et al., 2021). The skills required for the interpretation of UAS images represent one of the key points for the development of the sector and go beyond flight planning and its implementation. The development of user-friendly software could be a turning point for the complete dissemination of these methodologies, still too difficult to be performed by those who do not have specific training.

References

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